

NASA AEROSPACE SAFETY ADVISORY PANEL
National Aeronautics and Space Administration
Washington, DC 20546
Dr. Patricia Sanders, Chair

July 26, 2021

Senator Bill Nelson
Administrator
National Aeronautics and Space Administration
Washington, DC 20546

Dear Sen. Nelson:

The Aerospace Safety Advisory Panel (ASAP) held its 2021 Third Quarterly Meeting via teleconference July 13-15, 2021. We greatly appreciate the participation and support that were received from NASA leadership, the subject matter experts, and the support staff.

The Panel submits the enclosed Minutes resulting from the public meeting for your consideration.

Sincerely,



Patricia Sanders
Chair

Enclosure

AEROSPACE SAFETY ADVISORY PANEL

Public Meeting

July 15, 2021

Conference Call

2021 Third Quarterly Meeting Report

Aerospace Safety Advisory Panel (ASAP)

Attendees:

Dr. Patricia Sanders, Chair
Lt Gen (Ret) Susan Helms
Mr. Paul Sean Hill
Dr. Sandra Magnus
Dr. Amy Donahue
Mr. William Bray
Dr. George Nield
Mr. David West
Dr. Richard Williams

Telecon Attendees:

See Attachment 1

ASAP Staff and Support Personnel

Attendees:

Ms. Carol Hamilton, NASA ASAP Executive Director
Ms. Lisa Hackley, NASA ASAP Administrative Officer
Ms. Kerry Leeman, Technical Writer/Editor

Opening Remarks

Ms. Carol Hamilton, ASAP Executive Director, called the meeting to order at 2:00 p.m. ET and welcomed everyone to the ASAP's Third Quarterly Meeting of 2021. She indicated that no comments or statements had been submitted prior to the meeting, but time would be allocated at the end for public comments.

Dr. Patricia Sanders, ASAP Chair, opened the meeting by stating that over the past three days, the ASAP conducted its Third Quarterly insight discussions once again in a virtual format. She thanked all the participants and "IT genies" who worked with the Panel—across multiple time zones—to facilitate productive engagement between NASA and the ASAP. Dr. Sanders added that the Panel looks forward to meeting in person again, potentially for the Fourth Quarterly in September.

She indicated that the ASAP deliberately structured the Third Quarterly's discussions to focus on the strategic-level issues, which were first raised in the ASAP 2020 Annual Report. While the Panel was not able to engage with all of the individuals they wanted to at this session, they will continue deep dive discussions into what they consider critical risk management issues. Dr. Sanders then invited Mr. Paul Hill to discuss some of the ASAP's observations.

Strategic Issues

In the ASAP 2020 Annual Report, and going into this year's quarterly meetings with NASA, the Panel made a point that they wish to explore broader and more strategic topics with the Agency. Mr. Hill reiterated that as described in the annual report, such topics of interest include:

- What role NASA intends to perform going forward and why.
- How the Agency will interact with both commercial and international partners.

Mr. Hill stated that there are no particular strategic decisions the Panel is principally focused on. Rather, the Panel is interested in the *process* through which the Agency makes decisions, and how it then sets the program strategies from Headquarters down to the Centers—and also with its partners and customers—so the NASA team is aligned for consistent decisions and execution of those strategies.

As the Panel discussed again this week, the Agency's human spaceflight programs have evolved over the decades, not just in keeping up with technology, but also in program formation and management. The evolution includes incorporating international partnerships into Agency missions and increasing the use of commercial acquisitions, the latter of which leverages NASA's experience in the Commercial Crew and Cargo Program, observed Mr. Hill. The drivers for these evolutions include the desire to reduce costs, incentivize innovation, and foster international cooperation and a commercial space industry. Even with this evolution, Mr. Hill indicated, the risks associated with flying in space remain high and unforgiving of oversights and errors.

NASA has also employed a range of acquisition methodologies, from government-led development and operations at one end of the spectrum—the traditional approach used by the Agency for decades—to the acquisition of services and equipment from vendors where NASA is the customer, at the other end of the spectrum, noted Mr. Hill. In between those two complete “hands-on” versus “hands-off” acquisition models lies a range of government-contractor partnership approaches, he added.

All of these changes—both in program formulation and in acquisition methodology—also necessarily lead to different management processes for all cost, schedule, and technical considerations, including risk management, asserted Mr. Hill. NASA is in a unique position to leverage its experience with commercial partnerships to develop guidance for future program formulations. In fact, Mr. Hill observed, NASA can not only curate best practices for the Agency, but it can also serve as an example for other government agencies who are interested in pursuing similarly partnered acquisition approaches.

Again, leveraging NASA's experience with the full range of program methodologies:

- What types of services and equipment are best suited for programs at either end of the spectrum or as partnerships, both for cost and technical risk management?
- What are the program management risks associated with any of those options for each procurement, and what best practices has NASA found to mitigate those risks?

Examples of best practices, Mr. Hill articulated, include data sharing between providers and NASA, engineering review processes, and formal risk assessment, mitigation, and acceptance

processes. They should also include contractual considerations that NASA has found to be necessary to facilitate those best practices.

Documenting experience in formulating and executing programs across this spectrum, Mr. Hill emphasized, will enable NASA—and other government agencies in future procurements—first to deliberately assess the range of acquisition types and the cost and technical risks associated with each, and then to structure program management teams and processes to manage those risks most effectively. Not only does this provide the benefit of NASA’s unique experience in managing commercial partnerships, but it also directly addresses the following question from the ASAP 2020 Annual Report:

What *deliberate* management mechanisms will NASA employ from Headquarters down to the supporting organizations to assess which flight elements and/or mission services to “execute” versus “buy,” and how will NASA *deliberately* manage the associated risks?

Mr. Hill stated that in the absence of a deliberate approach to assessing and matching acquisition strategy to program risks and formulations, NASA is left to decide each on an ad hoc basis with the concern that some risks may not be fully communicated and reviewed, nor appropriately managed. Further, in an environment where ad hoc decisions become the norm and upper management is either not applying rigorous criteria or not engaging the organization in the formulation, managers and the workforce are left to accept the decision as a fait accompli—a behavior that can become a habit of simply accepting direction without proper diligence and eventually leads to unintended and undesirable consequences.

Dr. Sanders thanked Mr. Hill for his observations and reflected that the Panel expects more to come on these strategic topics in the future. She then directed attention to the myriad of ongoing NASA efforts, noting that it is indeed a time of high ops tempo for the Agency. Lt Gen Susan Helms was invited to lead off with discussion points of ASAP’s reviews with the Commercial Crew Program (CCP).

Commercial Crew Program

Lt Gen Helms indicated that the Panel had the typical opportunity this quarter to dialogue with the CCP Manager, Steve Stitch, and his team on the current status of the CCP. Of note, in addition to the ongoing discussions surrounding the overall program and the progress of two providers, SpaceX and Boeing, the Panel was able to review the work accomplished in response to the Orbital Flight Test (OFT)-1 mishap of December 2019, and the status of action items related to that investigation. At this time, Lt Gen Helms stated, all 80 of the necessary corrective action items generated by the investigation have been closed, either because they have been completed, or in a few cases, because the NASA team has determined that a suitably robust plan is in place to complete those actions by Crewed Flight Test (CFT). In addition, NASA has completed the Organizational Safety Assessment (OSA) of Boeing, which focused on the safety culture of Boeing and included interviews of over 100 personnel at Johnson Space Center (JSC) and Kennedy Space Center (KSC). In the next few weeks, the results of this OSA will be briefed to the NASA team and to Boeing. The Panel strongly encourages NASA and the CCP to consider incorporating the findings and recommendations of the OSA before Boeing proceeds with CFT.

The next topic refers to the Panel's ongoing concern about the evolution of NASA's relationships with commercial contractors, given that service contracts are becoming a core approach of both CCP and the Artemis campaign. In the past, using traditional approaches, NASA has rightly encouraged a "badgeless team" environment, which was appropriate for the structure and acquisition context of previous programs, stated Lt Gen Helms. By its very nature, however, the "service provider" paradigm draws distinctly different lines of authority and responsibility between a provider and the customer, especially with respect to risk management. In many ways, NASA is still applying the "old-think" of an integrated, badgeless team, including the use of verbal language that implies a traditional relationship with contractors during discussions with the Panel. To the Panel, these repetitive instances indicate a continuing struggle by NASA to recognize and clearly communicate the *modified* lines of authority, responsibilities, and accountability that must be developed, refined, and codified under service provider contracts.

However, paradoxically, although the very nature of a service contract drives more of a "hands off" approach by NASA with the provider, NASA is ultimately accountable for crew safety and mission assurance, and that role can never be fully deferred to a contractor, maintained Lt Gen Helms. Therefore, it is the view of the Panel that NASA must be proactive, and a leader in the shaping of a risk management paradigm applied throughout development, even as NASA must allow service providers to innovate in acquisition, and exercise of-the-moment technical and business practices. One of the key "lessons learned" the Panel identified in the ASAP 2019 Annual Report was the importance of early engagement with industry, including establishing an integrated NASA-industry team at the beginning of the program to build a sense of mutual trust, and embedding government representatives with key providers. Within the CCP, Lt Gen Helms stated, NASA has done an outstanding job of reactively assessing risks in mature technical baselines, but it is the view of the Panel that NASA should continue to mature its role in proactive risk management, and clearly articulate risk management roles and authorities in service contracts, including the necessary elements of oversight, transparency, and decision-making. In doing so, the Agency can better proactively manage risk instead of reactively mitigating those risks inherent in the systems that are delivered to them. Of special note, Lt Gen Helms indicated, service contracts being shaped today for the Artemis campaign must incorporate such provisions to better reflect NASA's overall responsibility for crew safety and enterprise mission assurance, and to alter any lingering perceptions of a "hands off" dynamic when it comes to risk management.

A separate but related issue involving service contracts is the issue of data sharing. The Panel appreciates that by its very nature, a service contract involves proprietary information unique to a service provider. However, Lt Gen Helms emphasized, the experiences of the CCP have revealed that the safeguarding of proprietary information has led to an environment of more restricted operational communications and legal constraints to data sharing. In addition, she noted, valuable knowledge, experiences, and lessons learned related to service provider spaceflight hardware and software are apparently often unavailable as a resource for broader systems engineering awareness and appropriate risk management improvements across the enterprise. Lt Gen Helms stressed that this is a situation that must be addressed now, and must involve not only senior managers, but competent legal advisors who can help to shape future contractual vehicles in a manner that will maximize the ability to share critical risk management-

related information. She echoed the Panel's sentiments by stating that without specific, proactive attention, future commercial contracts may, by default, include inhibitors to data sharing that not only create onerous mission management and operations, but also lead to gaps in knowledge and communications in a manner that increases risk.

And finally, it has come to the Panel's attention that these data sharing concerns extend to export control issues that inhibit crew readiness. Although export control of highly technical information is generally a valid concern and the law of the land, in NASA's case, the current law is being interpreted in such a way as to greatly constrain the ability of international astronauts to train and prepare for future spaceflight missions, observed Lt Gen Helms. International astronauts are full partners in the International Space Station (ISS) program, and by default, the CCP, where they have traditionally been treated no differently than American astronauts when it comes to overall astronaut training, including years of operational training and simulations that occur before a flight assignment. However, as interpreted today, the Panel understands that these international astronauts are precluded from participating in any kind of familiarization training and realistic operational practice until they receive specific flight assignments. Only then, Lt Gen Helms noted, will international astronauts receive an exception that allows them to see necessary space training materials, and become familiarized with the CCP spacecraft. The Panel strongly encourages NASA management, with the help of competent legal advice, to formulate a set of solutions that will allow international astronauts to receive the necessary exceptions at the beginning of their astronaut status situation so that they can fully participate in the essential pre-assignment training experiences of their American counterparts.

Dr. Sanders thanked Lt Gen Helms for her discussion points, and indicated that the Panel will provide its observations on the Exploration programs—Exploration Systems Development (ESD), Advanced Exploration Systems (AES), and the attendant architecture work. The Panel did not spend significant time on the Human Landing System (HLS) as part of the Third Quarterly's agenda, given the blackout due to the ongoing resolution of the acquisition protest. The Panel will look into HLS activities more deeply once the blackout period has concluded. However, Dr. Sanders stated, the Panel remains of the opinion that there is huge benefit to finding some way—including the resources—to go forward with more than one option for a critical and challenging component of the lunar exploration process. She then turned the discussion over to Mr. William Bray and Dr. Sandy Magnus.

Exploration Systems Development and Advanced Exploration Systems

The Panel once again held discussions with the ESD, AES, and Human Exploration and Operations (HEO) teams on their systems engineering and integration (SE&I) and architectural approaches, and their progress to date. Mr. Bray indicated that the Panel was impressed with the NASA team's progress and continued maturation, particularly with the SE&I efforts. Through engagement during this session with various NASA organizations and teams, it is evident to the Panel that the SE&I team is demonstrating the necessary engineering rigor and discipline to achieve the following:

- Define, allocate, and produce key requirements and other engineering artifacts to support a safe and effective design.

- Manage, mitigate, and eliminate risks as they emerge.
- Develop the necessary tools and capabilities to establish a robust end-to-end integrated test capability.

Mr. Bray praised Erika Alvarez and all of her SE&I teammates. The Panel recognizes that through their governance model and established processes, the NASA team is jointly producing the required engineering artifacts and tackling emerging technical issues in order to achieve a robust design in support of the Artemis II through IV missions. Their efforts are demonstrating effective and transparent communication and collaboration across, up, and down the NASA engineering and technical authority organizations. The Panel looks forward to seeing their efforts continue to progress and contribute to Artemis mission success.

For HEO, Mr. Bray continued, their mission architecture definition and engineering efforts remain extremely important for the longer duration mission sets beyond Artemis IV that will establish a lunar base en route to Mars. This work is necessary to define the top-level requirements, identify capability gaps and resultant technology investment requirements, and develop mission concepts of operations for the future and for the more complex Artemis mission sets. As noted in previous ASAP reports, the Panel views this work as architecture and mission engineering, and not a traditional SE&I function.

As HEO produces future mission architecture artifacts, the application of modular and open system design concepts will become increasingly important, Mr. Bray stated. As was discussed with HEO during the week of insight meetings, modular and open system designs hold the promise of enabling future design extensibility and ease of integration of technology to meet long-term challenges. And, through component commonality, modular and open system design has the potential to achieve a smaller logistic and sustainability footprint for support equipment, tooling, and sparing, which can drive down weight requirements critical for lunar base operations, longer-term missions, and ultimately the mission to Mars, Mr. Bray affirmed. The Panel looks forward to further discussions with HEO and SE&I on this topic.

Mr. Bray turned to Dr. Magnus to comment on Artemis program status.

Dr. Magnus indicated that a lot of excitement is building for the Artemis I launch. The core stage, solid rocket boosters, and Interim Cryogenic Propulsion Stage (ICPS) have been stacked; the Orion vehicle is next. The team at KSC is working hard to complete the processing and critical integrated testing that remains as NASA steadily works toward a future launch date, she stated. She added that it is impressive how much has been done, but there is still a lot to do. After waiting a very long time, the whole community realizes the nation is on the cusp of launching one of the most impressive rockets ever built; however, the Panel would like to sound a note of caution. As the finish line grows closer and closer to the major milestone of the Artemis I launch, Dr. Magnus emphasized that it is important that the whole team—from the technicians working on the vehicles, to the front-line managers at the processing facility, to the individual program managers located across the various NASA Centers and the team at NASA Headquarters—not let themselves be seduced into “launch fever.” Rather, she advised, everyone needs to remain on a steady, diligent, and disciplined path to launch. It is at this moment, so close to the end goal, that impatience can influence decisions and the perception that “schedule as king” can overturn process and procedural discipline. The Panel encourages the whole team to stop and

occasionally take a deep breath to remember the big picture—it is important to continue to do everything right and with deliberation and not rush toward any specific date. Dr. Magnus stated that she is hugely looking forward to the successful launch and execution of the Artemis I mission, which she indicated will be the inevitable result of a mindful, appropriately paced process flow.

Beyond Artemis I, Dr. Magnus indicated, the lunar campaign, which includes both the ESD and the AES division, is a complex ecosystem of multiple programs in various phases of definition, acquisition, and development—a dynamic that will continuously be present as the infrastructure and equipment necessary to implement the ultimate goal of a sustained presence on the Moon phases into existence. It is difficult to manage risk across the complex and time-phased program development that is unfolding, she continued. NASA has chosen to use a variety of acquisition models to implement the lunar campaign strategy, mainly with a goal of encouraging private industry to invest company resources that further NASA missions and simultaneously create “leave behind” capabilities available to incubate a government-independent space economy. Dr. Magnus revealed that proactive risk management, as opposed to a reactive risk mitigation posture, is even more complicated when different contractual models are in play. In order to help NASA manage risk, and to entice private industry to engage in what might be considered risky or limited projects over a very long period of time, NASA should have incremental funding authority across the ecosystem of programs that encompasses the lunar campaign. With established and well-defined funding profiles, Dr. Magnus stated, the Agency is able to make appropriate technical and operational trade-offs during development, decreasing risk that inevitably accumulates in operations due to up-front sub-optimal design trades that are forced due to constrained budgets. In addition, she continued, an incremental funding authority signals to private industry that NASA is committed to the program or project, and it provides stability for companies who might otherwise perceive that the risk of engagement is too high to proceed, especially in light of what are likely to be continuing budget discussions.

In summary, Dr. Magnus observed that there are a lot of moving parts involved in sending humans back to the Moon: the transportation system; the Gateway, which is in and of itself a system of systems; the lunar lander; the lunar habitat and supporting infrastructure; surface space suits; and ground transportation. She recommended that NASA should be given as many tools as possible to help manage the risk across all of these elements, and incremental funding authority is an important one.

Dr. Sanders remarked that Dr. Magnus’ comment about the Space Launch System being “the most impressive rocket ever built” was originally described in even more colorful language to the Panel. Of course, Dr. Sanders continued, no examination of ongoing NASA programs or operations is complete without a look at the ISS. She invited Mr. David West to provide insight into that topic.

International Space Station

Mr. West stated that the Panel had a very interesting discussion earlier that morning with ISS Program Manager, Joel Montalbano. The operations tempo and level of activities on the ISS continue to be amazingly high, he noted. After over 20 years of on-orbit operations of the ISS, the current Increment 65 has logged 70 new science investigations. To date, there have been

nearly 3,000 investigations conducted on the ISS, involving over 100 countries. As the Panel has mentioned in previous annual reports and at numerous quarterly meetings, the continuation of the unique capabilities that are currently only provided by the ISS is essential to supporting NASA's ongoing plans for future space exploration. Mr. West noted that serious discussions among NASA and its international partners are taking place to consider extending ISS operations through 2030.

The commitment to extending safe and fully capable ISS operations is evidenced by a couple of important missions, he observed. During recent spacewalks, U.S. astronauts accomplished the successful installation of two brand new ISS roll-out solar arrays. Mr. West indicated that these solar array installations, and more that will take place in the near future, will ensure reliable electric power is available to the ISS for years to come.

A new Russian module, the MLM, is planned to be launched and docked to the ISS within the next month. Mr. West stated that the MLM will provide enhanced support to services and functions and will add significant new capabilities, including additional crew quarters, solar arrays and a deployable radiator, internal and external science operations, and the European Robotic Arm.

The Private Astronaut Mission (PAM) program and a Russian plan to conduct filming of segments for a movie aboard the ISS are expanding the quantity and breadth of activities that will occur on the space station. The exact activities of the members of the Axiom Mission 1 (Ax-1) are still being defined. In addition, Mr. West continued, the Russian film project is also not yet finalized, although the plan includes launching an actress and movie director on a Soyuz flight later this year. While the types of activities are still being defined and the operational plans are in development, the Panel was assured that NASA is watching these activities for strict compliance with the NASA Interim Directive (NID) on "Use of the ISS for Commercial and Marketing Activities," as well as for any risk or operational impacts for the ISS crews. The Panel urges NASA to not just monitor compliance with the NID, but to carefully make related decisions in accordance with a rigorous risk management process.

The Panel continues to closely follow the status of the investigation into the leaks present in the Russian ПрК module. Russian and NASA experts have been using a number of methods to try to pinpoint exact locations of any further leaks beyond the ones already identified. The ongoing troubleshooting has identified several areas of interest. Patches or sealant have been applied in three of those locations, but without completely decreasing the leak rate, informed Mr. West. While the leak does not currently pose a safety risk to the crew, the Panel will be interested in receiving status updates on the situation as they develop.

Mr. West discussed another very significant issue presented by the ISS team, the recent hit to the Space Station Remote Manipulator System, or robotic arm, by a small orbital debris particle. Photographic analysis indicates that the particle created an impact site with a diameter of just under a half-centimeter. Loads on the robotic arm are currently being limited to 50% of the baseline until an assessment of the boom torsional strength is complete, he noted. While this temporary derating is not impacting any near-term operations, Mr. West observed, the debris hit is an important reminder of the fact that orbital debris has been identified and still remains the top risk for the ISS (and other space vehicles). The Panel would like to reiterate their

recommendation of the urgency for Congress to designate and fully resource a federal agency responsible for coordinating space traffic management and the control of orbital debris. The Panel deems that NASA needs a fully authorized and fully resourced federal partner in order to manage, and hopefully decrease, micro-meteoroid and orbital debris (MMOD) risks to human spaceflight.

Dr. Sanders thanked Mr. West for sharing his observations and stated, in case it was not clear, that the MLM previously described is a Russian-developed module, and indicates continued commitment of that partner to the space station. She added emphasis to what Mr. West said about the importance of addressing the MMOD and space traffic management issues. The hazards facing all space-related endeavors remain high, and while NASA has made significant progress on attacking the problem within its realm of responsibility, the Panel is still very focused on Congress acting on the formal recommendation to them and will continue to press on this critical issue.

Another topic the ASAP addressed earlier concerned activities to facilitate commercial enterprise in low-Earth orbit (LEO). Dr. George Nield was invited to lead the discussion.

Commercial Low-Earth Orbit Destination Status

Dr. Nield indicated that NASA recently released a draft announcement for proposals for commercial LEO destinations, which NASA refers to as CLDs, and held a pre-proposal conference. NASA's plan is to execute the program in two phases. Phase 1 would include the formulation and design of CLD capabilities. It is envisioned to include two to four companies, and it would total \$400 million over a four-year period (from FY22-FY25). The current President's budget request for the program is \$101 million for FY22. To prepare for the possibility that Congress does not provide that level of funding, NASA is looking at potential impacts, including a reduction in the number of awards, a rephrasing of near-term milestones and activities, and a potential slip in the overall schedule, Dr. Nield informed. Phase 2, he noted, is planned to be a fixed-price, full and open competition for the procurement of services to transport NASA crews, payloads, and equipment to—and accommodation on—a CLD, and return to Earth, as well as waste disposal. The goal would be for a CLD to be operational by 2028, which would provide a two-year overlap with the ISS, assuming the ISS is in fact extended to 2030.

Dr. Nield stressed that in order to avoid a gap in human capabilities in LEO, it will be important for the new destinations to be up and operating prior to the retirement of the ISS. Congress has indicated that it has questions about NASA's goals and metrics for a transition from the ISS, so it will be very important for NASA to quickly provide Congress with the requested information and come to an agreement on the appropriate schedule and funding levels.

A second topic of interest to the Panel is PAMs. Axiom has been selected to perform the first PAM, Ax-1. The mission is planned for a January 2022 launch, using a SpaceX Falcon 9 booster and a Crew Dragon capsule, and it would have a total mission duration of 10 days, including 8 days docked at the ISS. Michael Lopez-Alegria, a former NASA astronaut, will be the Commander of the mission, which will also include three other private astronauts. Axiom crew training has

already begun at SpaceX, and ISS training is scheduled to start in August. NASA is currently soliciting proposals for the next two PAMs, with proposals due on August 5.

Flying private astronauts to the ISS will involve significantly less screening and training than is normally used for professional astronauts, advised Dr. Nield. As a result, there is a potential for additional risks, both to the private astronauts themselves and to other crewmembers, as well as to the ISS itself. For these missions to be successful both for the private astronauts and for NASA, it will be necessary for there to be realistic expectations on each side, so spending some time and energy on expectation management will be a key, Dr. Nield indicated. NASA is attempting to mitigate those risks by scheduling the private astronauts for special interview sessions with a panel consisting of flight crew and flight operations representatives, and through careful oversight of the training that will be conducted at JSC. Dr. Nield stated that although it is currently not a contractual requirement for PAM Commanders to have spaceflight experience, the fact that a former NASA astronaut will be the PAM Commander on the Ax-1 mission should help NASA in assessing whether additional criteria may need to be added to the contracts for future missions. The ASAP recognizes the potential benefits of stimulating commercial demand for human spaceflights to LEO. However, the Panel will be interested to see what specific policies and procedures NASA decides to implement to ensure overall mission safety.

Dr. Sanders thanked Dr. Nield for his insights. She then pointed out that the Panel's engagements over the last week were rounded out by an interchange with the NASA Chief Medical Officer on a number of topics that bear on the safety and welfare of the NASA workforce. She introduced Dr. Rich Williams to summarize these discussion points.

Health and Medical Update

The NASA Health and Medical Technical Authority continues its intense support of all human spaceflight programs. Dr. Williams noted that attention is currently focused on the technical authority areas of concern on the Boeing spacecraft and the upcoming OFT-2 mission, in preparation for supporting eventual human-rating of the Boeing spacecraft.

Evolving societal dynamics including new perspectives, equity objectives, and social expectations are driving the Agency to reexamine some of the standards and requirements that govern health and medical decision-making, specifically pertaining to medical qualification for astronaut selection and spaceflight, stated Dr. Williams. NASA medical authorities are working to determine where medical standards can and should be adjusted to broaden opportunities for people with certain disabilities, as well as transgender people.

Earlier this year, the European Space Agency announced the Para Astronaut Feasibility Project, which invited applications to their astronaut program for:

"People who have all qualifications required to become an astronaut and the following disabilities:

- Persons who have a lower limb deficiency (e.g., due to amputation or congenital limb deficiency) as follows:
 - Single or double foot deficiency through ankle.
 - Single or double leg deficiency below the knee.

- Persons who have a leg length difference (shortened limbs at birth or as a result of trauma).
- Persons of short stature (<130 cm)."

Dr. Williams affirmed that there are precedents for aeromedical qualification and certification for amputees and people with other disabilities in the U.S. military and the Federal Aviation Administration (FAA). NASA medical authorities are working through the safety implications of issues such as vehicle egress, microgravity-induced physiologic and anatomic changes, and space suit accommodation for people with limb prostheses and people of short stature.

There are precedents for medical and aeromedical qualification and certification of transgender individuals in the U.S. military and the FAA as well, stated Dr. Williams. Gender dysphoria has previously been disqualifying for astronaut selection and medical qualification for spaceflight. In response to the President's Executive Order on Preventing and Combating Discrimination on the Basis of Gender Identity or Sexual Orientation, NASA has adjusted its medical standards to allow consideration of transgender individuals for selection and flight medical certification, and will refine those standards going forward based on best available evidence.

Dr. Williams then touched on another area of interest to the Panel—space radiation standards. In light of 20 years of long duration spaceflight experience on the ISS, and the ongoing results of the Lifetime Surveillance of Astronaut Health, NASA convened a committee of the National Academies to reconsider the space radiation career exposure standard. The proposed standard, still based on the risk of cancer and Radiation Exposure Induced Death (REID), has been revised to a maximum lifetime exposure of 600 mSv, regardless of sex. This is expected to enhance opportunities for both women and men in long duration LEO and exploration class missions while maintaining a 3% REID using central tendency around the mean, Dr. Williams indicated.

The NASA medical system and the ISS medical system, he continued, must also accommodate private, commercial astronauts. Commercial astronauts are aeromedically certified by the FAA, but they also must meet a set of NASA medical standards that assure health and safety in the space environment if the mission involves visiting the ISS. NASA is also participating in a multi-agency board to share human spaceflight experience with the FAA and the Department of Defense.

Dr. Williams concluded his remarks on NASA's health and medical status by stating that NASA Centers have moved to stage 2 in their response to the COVID-19 pandemic. Workers are allowed back on site at 25% capacity, and some essential but non-mission-critical travel is allowed. NASA is watching the current rising case rates nationally, and the evolution of the Delta COVID-19 variant, and will proceed with caution in accordance with White House and Centers for Disease Control guidance.

Dr. Sanders thanked Dr. Williams for his update, and noted that the Chief Medical Officer position, which Dr. Williams once filled, clearly has one of the most critical, diverse, and interesting set of responsibilities in NASA.

As the discussions wrapped up, Dr. Sanders emphasized it is important to note that a recurring theme in many of ASAP's observations is the importance of clearly comprehending goals and

objectives, and also of effectively communicating them to the workforce and throughout the chain of stakeholders. This communication, she said, applies to clearly comprehending the direction NASA leadership intends to take the Agency, its relationship to shared risk management, and articulating it to the commercial and international partners and the NASA workforce. It applies as well to the expectations for commercial LEO endeavors. Dr. Sanders reflected that it will be key for all parties to have a shared understanding of the objectives of these efforts, how they might be limited by the needs of NASA's primary missions, and how they impact the expectations of participants like the private astronauts.

Looking ahead, the Panel has a full plate. As indicated by Dr. Sanders, the Panel will be continuing to delve into the strategic risk management issues facing NASA. They will deep dive into the safety items associated with the HLS. Some Panel members will be observing an upcoming NASA Safety Audit, and will be following the adjudication of the recommendations made in last year's NASA Aircraft Fleet Safety and Sustainment Assessment Report. And of course, Dr. Sanders remarked, the Panel will continue to be occupied with the multiple ongoing NASA efforts.

Dr. Sanders then asked that the lines be opened for a few minutes for public comments. No comments were received.

Dr. Sanders thanked all the participants and adjourned the meeting at 3:00 p.m. ET.

ATTACHMENT 1

Note: The names and affiliations are as given by the attendees, and/or as recorded by the telecon operator.

PARTICIPANTS

Damien Mills	Boeing
Danny Lentz	NASA Spaceflight
David Millman	No affiliation provided
DC Charania	Blue Origin
Dee Russell	Boeing Company
Diane Rausch	NASA HQ
Dillon Macinnis	Space X
Erin Kennedy	GAO
Jamile Castillo	Coalition For Deep Space Exploration
Jan Bruegnann	No affiliation provided
Jeff Foust	Space News
Joey Roulette	The Verge
Josh Finch	NASA
Joy Kis	BAL
Katherine	NASA
Kathryn Hamilton	No affiliation provided
Lewis Groswald	Lockheed Martin
Linda Karanian	Karanian Aerospace Consulting
Marcia Smith	Space Policy Online.com
Michael Sheetz	CNBC
Mike Curie	NASA Commercial Crew Program
Natalie Logan	Government Accountability Office
Patricia Soloveitheik	Boeing
Paul Brinkmann	UPI
Rebecca Regan	Boeing
Rob Campin	No affiliation provided
Russ Deloach	NASA
Stephen Clark	Space Flight Now
Thomas Gaseor	Four Hawks Solutions LLC
Tracy Dillinger	NASA OSMA
Tremayne Days	NASA JSC
Zudayyah Taylor-Dunn	NASA